Climate Variability and Predictability Program (CVP)

CVP – Pre-Field Modeling Studies in Support of TPOS Process Studies, a Component of TPOS 2020

The CVP Program is a critical component of the integrated research enterprise at the NOAA Climate Program Office (CPO), and maintains important connections to the other CPO program areas. In order to improve understanding of the climate system and its representation in models we need high-quality, consistent, long-term observations of the many parameters of the climate system. The Ocean Observing and Monitoring Division (OOMD) of CPO provides high-quality long-term global observations, climate information, and products that are used by CVP-supported scientists to build improved theories for the complex dynamics of the many components of the climate system, and in turn OOMD is informed by the needs of the process modeling and climate variability community.

The fundamental overarching goal of the Tropical Pacific Observing System 2020 (TPOS) effort is to enhance and redesign international observations of the tropical Pacific. In the First Report of TPOS 2020 (Tropical Pacific Observing System 2020, tpos2020.org), many recommendations and proposed actions were identified. The use of process studies that will inform further refinement of TPOS was noted as a critical part of the implementation process that can guide the development of the system design. Two of the studies that are recommended in the report are called "Pacific Upwelling and Mixing Physics (PUMP)" (section 6.2.1) and "Air–sea Interaction at the eastern edge of the Warm Pool" (section 6.2.3). Each of these studies focus on improved predictability of the overall evolution of the Pacific climate system on seasonal to interannual timescales (MJO, ENSO, etc.), which is beneficial to NOAA's mission of improved environmental prediction. This solicitation is intended to contribute to the goals of TPOS 2020.

Process Studies Identified in the TPOS First Report - Summary Descriptions

Pacific Upwelling and Mixing Physics (PUMP)

The motivation of "Pacific Upwelling and Mixing Physics (PUMP)" is that equatorial upwelling is a poorly observed aspect of the climate system, yet a principal initiating mechanism for the vigorous ocean-atmosphere coupling of the equatorial Pacific. The most consequential equatorial upwelling occurs in the eastern and central Pacific Ocean, where the Equatorial Undercurrent (EUC) and thermocline rise from west to east, bringing cold water (<20°C) with high concentrations of nutrients and CO_2 to within 100 m of the surface. Upwelling and mixing in the east-central equatorial Pacific play a central role in ocean-atmosphere dynamics of the Pacific that engages the entire global climate. Despite its importance, the spatiotemporal variability and dynamical mechanisms of this interaction remain poorly understood and poorly constrained in climate models (see TPOS First Report, section 6.2.1 for further details).

Planning for the PUMP process study calls for: 1) An array of moorings and autonomous vehicles in the central or eastern equatorial Pacific to provide time series of the vertical-meridional structure of three-dimensional velocity in relation to the

temperature field; 2) Ship-based turbulence measurements to capture the relationship between upwelling and mixing, which would provide an important benchmark and constraint for climate models; 3) Formation of a team of modelers, observationalists, and theoreticians to allow for integration of field data into model improvements. The expected outcome of PUMP is increased information for upwelling/mixing physics and its parameterization schemes in ocean circulation and climate models. It will also help determine the minimum observations needed to quantify the Pacific upwelling and monitor changes over time.

Air–sea Interaction at the eastern edge of the Warm Pool

The motivation for "Air–sea Interaction at the eastern edge of the Warm Pool" is to understand the air-sea interaction processes and the role of upper ocean salinity stratification (barrier layer) in maintaining the warm SSTs at the eastern edge of the west Pacific warm pool, in particular focusing on the air-sea coupling on intraseasonal timescales. The western Pacific is characterized by a warm and fresh pool as a result of the warm water accumulation by the equatorial trade winds in the central Pacific and the heavy rainfall associated with ITCZ, SPCZ and MJO variability in the western Pacific. Within this warm, fresh pool there is significant variability of salinity structure, which can affect air-sea exchanges in heat, freshwater, and momentum and mixing (see TPOS First Report, section 6.2.3 for further details). Planning for this process study calls for using a mix of fixed platforms and mobile observing systems that would follow the evolving warm pool ledge.

FY18 Call for Proposals

In FY 2018, the CVP program solicits modeling projects that will refine the current scientific understanding of the equatorial Pacific climate system with a specific focus on two process studies identified in the TPOS 2020 First Report, "Pacific Upwelling and Mixing Physics (PUMP)" (section 6.2.1) and "Air–sea Interaction at the eastern edge of the Warm Pool" (section 6.2.3). Outcomes from the proposed projects will be used for pre-cruise planning and field campaign development. The CVP Program encourages a hierarchy of modeling approaches that help to inform one or more the following guiding questions:

- What aspects of the equatorial Pacific system should be observed during the the identified TPOS process study field campaign(s)? What sampling locations will maximize the effectiveness of the observations (geographic locations, ocean depth or atmospheric height, as well as temporal frequency)? What scales (spatial and temporal)? How might the observational plan change under changing conditions and/or background mean states (El Nino/La Nina) of the Pacific system?
- From a quantitative perspective, what kinds of observational technologies would be best used for sampling this system (floats/profilers, gliders, unmanned or autonomous vehicles, buoys, ship-based observations, aircraft, satellites, etc.)? What are the

strengths and weakness of each sampling approach for the Pacific system? Could these be used as an approach in the future for sustained observations?

- What sampling plan during the TPOS process study field campaign would have the biggest impact on the future improvement of model parameterization and/or making advances in model simulation of the Pacific upwelling and ocean-atmosphere system?
- Given that the eastern Pacific upwelling is confined to the upper ocean with multiple and overlapping physical processes, and which are confined to only a few upper layers of an ocean model, what new approaches might be used to improve simulation of the upwelling system in global climate models? How can the TPOS process study field campaign be used to test these new approaches?

It is envisioned that this initial set of model studies will be the first component of a longer-term research arc (dependent of future availability of funds) through the TPOS 2020 effort in collaboration with the CVP Program. Future efforts might include the development of an observational field campaign, designed and developed in coordination with the observing community, and follow on opportunities for the exchange of information between observationalists and modelers for the improvement of ocean and atmospheric models.

For this call for proposals, it is encouraged that the proposed modeling projects include a group that includes modelers, observationalists and/or observational theoreticians. Collaborations with NOAA Labs and Centers are encouraged but not required. Use of observations and associated modeling studies from recent NOAA-funded projects such as EPIC, PACS, VOCALS, DYNAMO, YMC and/or NMME is also encouraged but not required. Projects will start either in FY18 or FY19, depending on the needs of the project and the availability of funding.

Data Management Guidance

The Responsible NOAA Official for questions regarding this guidance and for verifying accessibility of data produced by funding recipients: Sandy Lucas, sandy.lucas@noaa.gov

Data Accessibility: The CVP Program requires that public access to grant/contract-produced data be enabled in one of the following ways (select one):

- ❏ Funding recipients are planning to submit data to NOAA National Centers for Environmental Information (NCEI), which will provide public access and permanent archiving[1]. Point of Contact for NCEI is Nancy Ritchey (Nancy.Ritchey@noaa.gov)
- ❏ Data are to be submitted to an International Council for Science (ICSU) World Data System facility: https://www.icsu-wds.org/community/membership/regular-members)
- ❏ An existing publicly accessible online data server at the funded institution is to be used to host these data (describe in proposal).
- ❏ Data are to be submitted to a public data repository appropriate to this scientific domain (describe in proposal).

[1] NCEI supports the creation of adequate metadata and data ingest into long term repository holdings using tools such as Send2NCEI (www.nodc.noaa.gov/s2n, for small volume, one-time only data collections) and Advanced Tracking and Resource tool for Archive Collections or ATRAC (www.ncdc.noaa.gov/atrac, for recurring and/or large volume data collections).

- ❏ Proposal may request permission not to make data publicly accessible (proposal to explain rationale for lack of public access, and if funded approval to be obtained from Responsible NOAA Official listed above).
- ❏ Archival of data at an established Cloud Computing facility, if cost effective and reliable

Technical recommendations:
The CVP Program requires the following data format(s), data access method(s), or other technical guidance:

- Data must be made available in a common machine-readable non-proprietary format with appropriate metadata and clear labels and descriptors. Use of netCDF is encouraged.
- Data should be available via public and discoverable data portals, as described above.
- At a minimum, investigators should plan to archive and make available modeling data used in producing any figures in publications from research supported by their grants, as well as data that support conclusions reached in papers or stated publicly. Only those data which are necessary for demonstrating reproducibility of published results need be archived and made public unless otherwise required as part of the solicitation.
- In situ observational data collected during the field campaign should be made freely available to the public either 2 years after collection and validation or at the time of publication, whichever is sooner.
- Model data should be made available for at least 3 years after it is initially published or made otherwise publicly available.

Resources:
Proposals are permitted to include the costs of data sharing and/or archiving in their budgets within solicitation specified proposal cost limit. Proposed methods and approaches should use reasonable means to minimize data management costs.

References:

Cravatte, S., W. S. Kessler, N. Smith, S. E. Wijffels, and Contributing Authors, 2016: First Report of TPOS 2020. GOOS-215, 200 pp. [Available online at http://tpos2020.org/first-report/]

Kessler, W. S., J. N. Moum, M. F. Cronin, P. S. Schopf, D. L. Rudnick, and L. Thompson, 2005: Pacific Upwelling and Mixing Physics (PUMP). A Science and Implementation Plan. US CLIVAR, Washington. [Available at http://faculty.washington.edu/kessler/clivar/PUMP_revised_Jan05.pdf.]

Program Contact information:
For additional program announcement information, investigators should contact the following CVP Competition Manager: Sandy Lucas (Sandy.Lucas@noaa.gov, 301-734-1253)
Letters of Intent should be submitted directly to the Competition Manager.